Primer for the Integrated Laser-driven Ion Accelerator System

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The high power laser driver enables detailed investigation of ultrafast laser-plasma interactions at extreme fields. Energetic particle and photon yields of these interactions are diagnostic but also indicate promise for laser-driven energetic particle acceleration as the basis of candidate sources for innovative laser-driven accelerator development. With the advent of the petawatt era, the extent of progress is indicated by the laser pulse energy scaling of typical ion source spectra at the single shot level. However, applications will typically require repetition-rated delivery of confined particle beams that are stable, reproducible, controllable and suitably monitored. For laser-accelerated ions we then must consider the integrated laser-driven ion accelerator system or ILDIAS. Mindful of the potential for multiple applications, due emphasis on the integrated full system in an accelerator context goes beyond the microscopic scale of the localized laser-plasma setting and is therefore essential. ILDIAS is defined and its component progress is briefly discussed. A variety of applications can present a variety of ILDIAS requirements; one of the most stringent being laser-driven ion beam radiotherapy or LIBRT. Given the rapid impressive cyclotron and synchrotron developments in industry, a comparative assessment of the laser-driven case must be ongoing with a commensurately developing vision of en route milestone applications. As an innovative contribution to accelerator advancement, ILDIAS machine development and applications must pursue and exploit the uniqueness enabled by the high power laser-driver. Some guidance points are given for realistic long term strategic planning where the distinction between ILDIAS as the machine and specific applications is critical.